REMARKS

Applicants respectfully request reconsideration of the prior art rejections set forth by the Examiner under 35 USC sections 102 and 103. Applicants respectfully submit that the prior art references of record, whether considered alone or in combination, fail to either teach or suggest Applicants' presently claimed invention.

Specifically, with respect to the Examiner's rejections of claims 1-4, as well as 8-9, Applicants note that the Examiner bases the rejection of these claims primarily on the teachings of the Lopatin reference, United States patent no. 6,259,160 in combination with several other references. Significantly, as even recognized by the Examiner, neither Lopatin nor any of the remaining references specifically teaches or suggests the specified formation of the layer including oxygen formed over the clad layer (claims 1-4) or the silicon dioxide layer formed directly on the cobalt silicide (claims 8-9).

The Examiner asserts that this acknowledged deficiency is overcome by the general knowledge in the art concerning the formation of silicon oxides. In response, Applicants note that although silicon dioxide insulating layers have been used generally in the field of semiconductor processing, in copper wiring technology, silicon oxides or oxygen including layers have generally been avoided in the formation of copper wirings. Indeed, Lopatin recognizes this actual state of the art in column 6 at lines 8-13 wherein the specification states that: "the present invention facilitates the use of low dielectric material which results in a semiconductor structure that is free of Si3N4 or SiO2 in the copper interconnect region. . ."

Applicants submit that Lopatin actually teaches away from the presently claimed invention because Lopatin recognizes and indeed acknowledges that the use of silicon dioxide in the manufacture of copper wirings can be avoided altogether through the use of the technology described therein. In contrast, Applicants have disclosed and claimed novel manufacturing techniques which enable the use of Silicon dioxide insulating structures in the

manufacture of copper wirings. Applicants respectfully submit that the cited combination of references asserted by the Examiner in the rejection of claims 1-4 and 8-9 would not result in the presently claimed subject matter of the instant application. To the contrary, the cited combination of references teaches away from the use of Applicants' claimed silicon dioxide structure and instructs those skilled in the art to use an alternate insulating material. The alternate insulating structures of Lopatin are also more expensive than silicon dioxide yet further demonstrating the need in the art for a better solution than that described in Lopatin.

Prior to Applicants' invention in the instant application, the state of the art copper wiring manufacture processes would avoid silicon dioxide due to the concern over undesired oxidation of the copper wiring. The present inventors have overcome the these shortcomings by describing an improved structure and methods of manufacture that enable the use of less expensive insulating structures such as silicon dioxide. In light of the foregoing, Applicants request that the Examiner withdraw these rejections.

Applicants also submit that the rejections of the remaining claims in the application are similarly improper and should be withdrawn. In particular, Applicants note that the inventors have discovered novel manufacturing techniques that can be used to easily form the specified structures which enable the use of conventional silicon dioxide insulating layers in the manufacture of devices which utilize copper wirings.

The current invention contains certain advantages over the cited prior art beyond the Examiner's acknowledged novelty of forming a cobalt silicide layer in a single step. Examiner cites "Shacham-Diamand disclosing the electro-less deposition of copper, followed by electro-less deposition of CoWP with deposited films of Co and Si atop the CoWP to produce the sequence, Cu/CoWP/Co/Si, which is subsequently subjected to annealing at 400 degrees (C) for 30 minutes to 1 hour to produce a CoSi layer." The advantage of the current invention is that by using a single Silane gas method to create the CoSi layer, the deposition

of the CoSi layer can be performed using industry standard apparatus that are already used for CVD of the Oxygen containing layer. This is in sharp contrast to the use of an annealing process, which requires separate apparatus to heat the 2 layers of Si and Co to the correct temperature to induce annealing. In this way, the cost and complexity of upgrading current semiconductor processes to handle creating a cobalt silicide layer and subsequent oxygen containing layer is minimized. Furthermore, Applicants claimed method is more energy efficient and less time consuming than the allegedly obvious processing asserted by the Examiner.

In summary, the Examiner has made the bald assertion that the formation of a cobalt silicide by a two step process as contrasted to a single CVD process produces the same result and a functional working device and is therefore obvious. This conclusory rejection is improper and the facts do not support the Examiner's assertion. A proper obviousness rejection under 35 USC section 103 requires that the Examiner set forth some specific teaching or suggestion in the prior art that indicates to a person of ordinary skill in the art that the combination of prior art techniques should be combined in order to achieve the claimed subject matter. In the present circumstance, the Examiner has completely failed to provide any such teaching or suggestion whatsoever. Rather , the Examiner has made the unsupported assertion that the claimed subject matter would have been obvious.

Significantly, the closes prior art reference of record merely teaches that cobalt silicide can be formed by annealing a layer structure of Cu/CoWP/Co/Si wherein the layer structure is achieved by providing individual layers of the referenced materials. In contrast, Applicants have disclosed and claimed that a CoSi2 clad layer can be achieved by exposing a Cu/CoWP structure in a silane gas reaction system. Fundamentally, there is simply no teaching or suggestion whatsoever regarding the exposure of the Cu/CoWP structure in a silane gas reaction system. For this reason alone the rejection is improper.

The claimed subject matter is not the performance of two prior art steps in a single process as asserted. Rather, the claimed subject matter is entirely unique and non-obvious. The rejection is thus improper and should be withdrawn. There is simply no teaching or suggestion whatsoever in the prior art that even hints at or remotely indicates how the claimed subject matter can be achieved. Furthermore, as noted above, the art of record actually teaches away from the additionally specified formation of SiO2 through the addition of oxygen in the same silane gas system that is used for the formation of a cobalt silicide.

Claim 12 has been amended to more clearly distinguish the current invention's novelty over the cited prior art. The current invention contains certain advantages over the cited prior art beyond the Examiner's acknowledged novelty of forming a cobalt silicide layer in a single step. Examiner cites "Shacham-Diamand disclosing the electro-less deposition of copper, followed by electro-less deposition of CoWP with deposited films of Co and Si atop the CoWP to produce the sequence, Cu/CoWP/Co/Si, which is subsequently subjected to annealing at 400 degrees (C) for 30 minutes to 1 hour to produce a CoSi layer." The advantage of the current invention is that by using a single Silane gas method to create the CoSi layer, the deposition of the CoSi layer and the subsequent deposition of an Oxygen layer by CVD can be done using the same apparatus, thereby decreasing costs and complexity of the procedure, and the possibility of damage to the semiconductor by minimizing human and/or machine handling of the semiconductor. This is in opposition to using an annealing process, which requires separate apparatus to lay the 2 layers of Si and Co, and heat the device to the correct temperature to induce annealing.

The prior art of record fails to provide any teaching or suggestion whatsoever, even in combination, concerning this new manufacturing process. Applicants have provided new manufacturing techniques wherein the cobalt silicide clad layer can be advantageously formed in a very simple and convenient manner, using pre-existing fabrication equipment.

Additionally, a silicon dioxide layer can be easily formed by modifying or adding onto the processing techniques as specified, without the need for new equipment or additional handling of the semiconductor. The art of record does not teach or suggest these process innovations. Accordingly, Applicant's invention is patentable and distinct over the art of record. In light of the foregoing, Applicants respectfully submit that all claims now stand in condition for allowance.

Respectfully submitted,

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Robert J. Depke
HOLLAND & KNIGHT LLC
131 South Dearborn, 30th Floor
Chicago, Illinois 60603
Tel: (312) 422-9050
Attorney for Applicant